IRIA-ICRI Guidelines and Recommendations

(INDIAN RADIOLOGICAL AND IMAGING ASSOCIATION- INDIAN COLLEGE OF RADIOLOGY AND IMAGING)

Radiation and protocols in COVID 19 imaging

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Prepared by AERB committee of Indian Radiological and Imaging Association

RADIATION— FRIEND OR FOE?

- ✓ Natural emissions of ionizing radiation surround us and are found everywhere from the air we breathe, the food we eat, the ground we walk and the cosmic waves in our atmosphere. Such **background radiation** reaches a global average of **~2.4mSv/year** and can further increase in certain higher radiation hotspots and high altitudes.
- ✓ While these remain beyond our control, artificially generated radiations in the form of diagnostic and therapeutic x-rays prove to be a bone of contention when it comes to the risk benefit analysis.There is no denying that radiation exposure is an issue of concern due to its genetic and carcinogenic effects.
- ✓ However, the benefits easily outweigh the risks when used under advisable limits and guidelines and unnecessary radio-phobia should be addressed by creating awareness.
- ✓ To put things into perspective;-- One time air travel from New Delhi to New York would expose one to ~0.08mSv of radiation, whereas 1 Chest X ray offers a radiation of mere <0.1mSv which with modern techniques can be reduced down to 0.02mSv. Moreover, no scientific studies have yet found an increased incidence of malignancies in frequent fliers or airline pilots.

JUSTIFICATION:

- ✓ All the investigations involving X rays **must be clinically and radiologically justified.** Only valid referrals after establishing a valid clinical indication should be accepted.
- ✓ **Appropriate selection of imaging modality and protocol**, best suited to answer the clinical question at that point of patient management must be suggested by responsible radiologist/ clinical colleague in consensus.
- ✓ Unnecessary repetitions must be discouraged or should be allowed only if the clinical status of the patient demands so, as pulmonary infections show a significant lag in radiological resolution as compared with clinical resolution.

OPTIMIZATION:

The principal of **ALARA (as low as reasonably achievable)** must be practiced to optimize the individual radiation dosage. Adjusting the exposure settings to low kVp or mAs whenever possible, increasing the distance between X ray source and patient while decreasing the time of exposure, collimating the X-ray beam to area of interest are a few ways to reduce radiation exposure.

CT has emerged to be the most often ordered imaging modality for diagnosing pulmonary diseases. With the technical advancements, we are now able to strike a balance between attaining adequate imaging quality and the radiation exposure by tapering the acquisition protocol according to the clinic-radiological indication.

For CT scanners, using all possible methods of dose reduction in the equipment should be consciously done. Many protocols are automated in current equipment. Most **dose reduction techniques** are based on decreasing kVp, mAs, rotation time and duration of scanning; limiting the area exposed to ROI, using higher pitch in volumetric scanning, using appropriate collimation, filters and kernels; as well as post processing techniques like edge enhancement, to gain maximum possible spatial information.

HRCT protocols and radiation exposure

- Volumetric scanning in full inspiration has now superseded the conventional sequential technique. However, if availability is limited e.g. in peripheral centers, a sequential HRCT (1-2mm scans at 1.5-2 cm gaps) can be performed.
- Current suggested **HRCT technique** includes scanning in a supine position at end inspiration. It exposes the patient to ~**3-8mSv radiation** (kvp- 100-140, mAs- 120-200).
- Where repetitive imaging is required, **Low-Dose HRCT** should be recommended. It provides images of adequate diagnostic quality. The Radiation dose can be brought down to **~1-3mSV** by modifications in kvp- 80-120 and mAs-<100.
- **Ultra Low Dose HRCT**, can aid in further dose reduction by using the mAs, thereby reducing the exposure to **<1mSv**. However, at present their role is limited to screening and surveillance scanning.

Chest X-ray and their approximate effective radiation doses

Procedure	Average Effective Dose(msv)	Range Reported in Literature	Comparable to natural Background Radiation for
X-Ray Chest	0.1msv	0.05-0.24 msv	10 day

With **PA projection** the doses measured for the different devices were the following amorphous selenium system

- ✓ Routine Chest Xray 0.12+/-0.06mGy.
- ✓ CR system 0.3+/-0.05mGy
- ✓ DR system0.05+/-0.02mGy

Lateral projection amorphous Selenium system

- ✓ Routine chest X-Ray 0.40+/-0.13mGy
- ✓ CR system0.9+/-0.17 mGy
- ✓ DR system0.21+/-0.15mGy

The use of Digital system allows significant reduction of the patient dose. In particularly the Direct Radiography system, based on a Csl/a-Si detector,administers the lowest patient dose

Protection of Patient

1.Using High peak kilovoltage and low miliampere-seconds
2.By Using lowest acceptable Grid ratio
3. Beam restriction
4. By using shield to unexposed area
5.Filtration
6.By using Fast speed Film and intensifying screens
7.Periodic maintenance of machine

Ct scanners and their approximate effective radiation doses

CT SCANNER	Head		Orbit		PNS	
	Average Ct Dose (CTDIv) mGy	effective dose m Sv	CTDIv mGy	Lens dose/ effective dose		effective dose
Single slice	GE CT/I - CTDI – 40.1, toshiba - 34.112				toshiba - 19.67 mGy – CTDIw [2]	
4	55 mGy 3, 32 ± 4					
6	17.7 – 20 mGy 9					
8	58.2mgy 4 GE					
16	64.96 mGy 5,	1.2 +/- 0.5	104.45 +/- 6.7810	98.58 +/- 9.03 mGy10	15.9 – 26.9 14	0.73 – 0.94 mSv14
32	70.2 mGy +/- 18 (CTDIv) 5					
64	75 mGy (CTDIv) 5		58.34 +/- 7.08 mGy10	53.57 +/- 10.0710	57.7 +/- 34 mGy 15	10.05±5.94 15
128	69.2 m Gy 4	1.80 ± 0.24	Routine Head protocol - 47.55 mGy11 35.3 mGy 12 Low dose protocol – 4.1 mGy11 1.0 – 2.6	Routine head protocol – 4.9 mSv11 3.6 mSv 12 Low Dose protocol – 0.4 mSv11 0.1- 0.8	15.9- 21.4 14	0.6 – 1.4 mSv14 (Effective dose)

			mGy12	mSv		
256	30.4 mGy6					
320						
CONE BEAM	2.49 mGy [18]	1.2 mSv			2.9 – 5.7 mGy 16(Carestream 9300)	0.27 mSv (range 0.05-0.48 mSv
DECT	Siemens Somotom - 71.8 mGy 7	Siemens somatom 1.46 - 1.67			Siemens Definition flash – (low dose protocol)2.2 – 5.3 mGy 17	
	Siemens definition flash - 67.9 mGy 4					
	Siemens force dual source - 192 slice: 47.3 4					
sequential / axial scanner [4]						
4			75.1mGy13	70.2 +/- 1.5 mGy13		
8	58.2 mGY		66.5mGy	56.6 +/- 0.09 mGy		
16	57.7 to 62.8		85.8	71.5 +/- 2.4		
32	53.3 to 61.4					
64			Aquilion 64 – 113.3 Somatom sensation cardiac 64 – 58.9	Aquilion 64- 103.5+/- 7.2 Somatom sensation cardiac 64-		

				48.4 +/- 1.7		
HELICAL / MDCT [4]						
4			65.1	66.7 +/- 1.4		
8			50.9	45.6 +/- 0.7		
16	Somatom emotion 16 - 39.6		59.6	48.7 +/- 0.9		
32	54.1 - 54.5					
64	58.3		Aquilion 64 –96 Somatom sensation cardiac 64 – 51.5	Aquilion 64-82.3 +/- 7.3 Somatom sensation cardiac 64- 42.6 +/- 09		
128	50.3 - 58.3					
dect - 128	53.4					
dect - 198	47.3					

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